ADAPTIVE MODIFICATIONS OF THE REDUVIIDAE OF THE SCRUB JUNGLES AND SEMI-ARID ZONES OF THE PALGHAT GAP, INDIA — AN EVOLUTIONARY APPROACH[1]

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(With sixty text-figures in five plates)

Investigations on the tibiae of about 60 species of reduviids from the tropical rainforest, scrub jungle and semiarid ecosystems have shown different grades of development of tibial pads of the fore and mid legs. Tibial pads facilitate prey capture and they are totally absent in the characteristic species of the tropical rainforest ecosystem that provides an abundant supply of litter prey species. Tibial pads reach their maximum development in the characteristic species of the scrub jungle and semiarid ecosystems, where they have to depend on vagrant prey species that try to take shelter in the same concealment habitat. Diurnal activity; arboreal habit; alate condition without any type of sexual dimorphism with this regard; bright coloration; deposition of eggs in batches of 5-100 with strongly gluing material; eclosion — ecdysis — emergence periodicity in the fore and afternoons; almost straight and relatively slender rostrum etc. are complementary features of those species without tibial pads. Concealment habitats; alary polymorphism (females mostly apterous); warning coloration; deposition of eggs singly in several batches without any gluing substance; eclosion — ecdysis — emergence periodicity invariably during the scotoperiod; more curved stout rostrum etc. are complementary features of the species with tibial pads. Harpactorinae are represented by more number of species and are widely distributed in all three ecosystems whenever and wherever tropical rainforest conditions prevail and they are more original and are least specialized for life in the scrub jungles and semiarid ecosystems. Piratinae are extremely well specialized for life in semiarid zones and they are seldom found in tropical rainforests. Intermediate conditions of tibial pad development (pad-index) are found in Acanthaspidinæ.

Introduction

The evolution of the entire flora-fauna complex in a particular ecosystem is closely related to and profoundly influenced by the geomorphological evolution. Most of the peculiarities of the biogeography of India would remain meaningless if one ignores the decisive role of history on the changes in the land mass. Conditions operating at present have not given rise to the present day patterns of flora and fauna and their present day distribution represents a dynamic phase in the uninterrupted course of the biogeographical evolution in India that has by no means either stopped or even substantially slowed down. According to Mani (1974), the great bulk of true Indian

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flora and fauna had differentiated and evolved in the peninsula itself throughout the Palaeozoic, Mesozoic and Tertiary right nearly up to the Pleistocene and then spread over extra peninsular areas during late Tertiary. The original tropical humid forest fauna was very widely and continuously distributed throughout the peninsula. The presence of habitat fremd groups (ecologically anomalous) in the peninsula, according to Mani, is a strong evidence of the fact that formerly the whole peninsular fauna was a humid tropical one which was far more widely distributed throughout the peninsula than at present and that changes in the habitat have taken place within relatively recent times. Irreversible changes in the deterioration of ecosystems of the peninsula were induced by human agencies within historical times, since the close of last pleistocene glaciations on the Himalaya. Discovery of an increasing number of a wide range of pleistocene herbivorous mammalian fossils from the present day semiarid zones and scrub jungles of Southern India further convincingly support this view.

According to Champion & Seth (1968) and Meher-Homji (1974) the change from the original Miocene wet evergreen forest type to the present day dry evergreen type (Scrub jungle) may have taken place through an intermediate dry deciduous type, following the monsoon pattern of climate that originated subsequent to the uplift of the Himalaya and the maximum rise of the Western Ghats in the late Tertiary era. In most parts of the Palghat Gap, the annual rainfall rarely exceeds 600 mm, the dry season lasts for over eight months and the mean temperature of the coldest month seldom falls below 18°C. Geological changes are always indicated by phytosociology and the scrub jungles are associated with ferralitic sandy loams of mid Tertiary (Cuddalore sand stone formation). The characteristic composition of the fauna of a particular region is directly as well as indirectly influenced by the nature of the substratum (soil).

The geomorphology of Southern India is characterised by eastwardly directed offshoots of the Western Ghats that present a corona, having conditions similar to those of tropical rainforests; an apron of scrub jungles or dry evergreen forest (a product of human interference) and the plains consisting of the agroecosystem and the semi-arid barren land covered with thickets, sand dunes, chalk stones and granites. The substratum of the tropical rainforest ecosystem is humus laden, with an abundance of litter fauna such as Blattids,Termites, etc. providing a rich variety of food for an entomosuccivorous predator. On the contrary, in a chalk stone strewn hot semi-arid zone, where the impoverishment of prey species leaves no other alternative for a couching starved insect predator other than to wait in hiding for a stray, vagrant prey which, due to paucity of proper habitat conditions, tries to seek shelter underneath the same stone or a bark of a tree that invariably becomes its graveyard. Accumulation of heaps of cases of prey in a particular microhabitat is a sure indication of the presence of a predator. Studies on the natural history of a large number of species of Reduviidae of diverse habitats of the Palghat Gap, carried out in the Division of Entomology, Post-graduate Centre, Coimbatore for the past four years have prompted the authors to probe into several possibilities pertaining to the origin and evolution of structural adaptations of these bugs in this region.

Results and Discussion

1. *Distribution of Reduviidae of Southern India (Tamil Nadu)*:

From the collection data of 77 species of reduviids (owing to extensive damage caused to stored specimens, details of 55 more species could not be presented here with certainty) maintained in the Division of Entomology, it is evident (Table 1) that species abundance, morphological diversifications and ecotypic specializations are more significant in those species collected from the semi-arid zones of the Palghat Gap. Out of the 77 species investigated, 64 species have been recorded in the semi-arid zones, 25 from the tropical rain forests and 17 from scrub jungles. Out of these, eight species, viz. *Coranus atricapillus, C. spiniscutis, Coranus* spp. (2), *Acanthaspis zebraica, Triatoma rubrofasciatus, Ectomocoris ochropterus,* and *Rhinocoris marginellus* are found exclusively (characteristic species) in the semi-arid zones; two species, viz. *Rhinocoris* sp. and *Petalochirus brachialis* are found exclusively in the scrub jungles and eleven species, viz. *Holoptilus fasciatus, H. melanospilus, Irantha armipes, Lophocephala guerini, Endochus cingalensis, E. iroratus, Euagoras plagiatus, Cydnocoris gilvus, Polididus armatissimus, Sycanus ater* and *Nabis capsiformis* (Nabidinae) are exclusively found in the tropical rainforests as well as in the corona of hillocks where tropical rainforest conditions prevail. Five species, viz. *Raphidosoma atkinsoni, Rhinocoris fuscipes, Acanthaspis pedestris, Ectomocoris erebus,* and *Piratus affinis* have been found in semi-arid zones, in scrub jungles as well as in the aprons of the tropical rainforests during summer when conditions of scrub jungles prevail. *Sphedanolestes aterrimus,* an inhabitant species of tropical rainforest is found in areas of the scrub jungles during heavy monsoon when tropical rainforest conditions prevail. However, the presence of *A. pedestris* in a very restricted rocky area of a dense tropical rainforest in the Palghat Gap, creates considerable interest. This species is a characteristic species of scrub jungles and semi-arid zones and manifests extremely variable ecotypic characters (Livingstone & Ambrose 1978b). Whereas all ecotypes of this species collected from these two ecosystems do not exceed 14 mm in length and 4 mm in breadth, the ecotype of the tropical rainforest is not less than 16 mm long and 4.5 mm broad, with relatively longer appendages and is more darkly pigmented. While all available ecotypes of the two ecosystems could be readily reared successfully in the laboratory on camponotine ants, the tropical rainforest ecotype refuses to feed in captivity and fails to continue all its activities under laboratory conditions. It may tempt one to suggest that the tropical rainforest ecotype of *A. pedestris* may have been transported from the plains by human agency in the process of transport of timber, granites and other building materials and due to ecological isolation acquired certain specialized

TABLE 1

ECOMORPHOLOGICAL DISTRIBUTION OF REDUVIIDS OF TAMILNADU (cf. Figs. 58, 59 & 60)

MORPHOLOGICAL VARIATIONS	HABITAT		
	SEMIARID ZONES	SCRUB JUNGLES	TROPICAL RAIN FORESTS
1. Alate forms	48	10	16
2. Brachypterous forms	3	2	3
3. Micropterous forms	1	1	1
4. Apterous forms	12	4	5
5. Species with tibial pads both in the fore- and mid-legs	33	13	9
6. Species with tibial pad only in foreleg		1	0
7. Species without tibial pad	32	4	16

adaptations for life in tropical rainforest.

It is clear from Fig. 58 that Coimbatore District which is located in the Palghat Gap has the maximum number of genera and species of reduviids recorded.

Fig. 59 indicates that Harpactorinae predominates with 32 species, closely followed by Acanthaspidinae (22 species) and Piratinae (19 species). The least represented families are Tribelocephalinae and Nabidinae. The latter subfamily is now removed from Reduviidae. But, for the purpose of tracing its relationship in respect of the development of tibial pad, it is treated here along with Reduviidae. Interestingly, the subfamily Apiomerinae is not represented. Fig. 60 shows that the tropical rainforests and semi-arid zones have larger number of alate species whereas in scrub jungles, the apterous species predominate.

Table 1 indicates that though the number of species recorded in the semi-arid zone is more, the number of characteristic species recorded (endemic) in the tropical rainforests is significantly high. Whereas the characteristic species of the semi-arid zones and scrub jungles are either alate, micropterous, brachypterous or apterous and most of them are provided with tibial pads of varying degrees of development, all the characteristic species of the tropical rainforests are significantly (without any exception) alate and all are without tibial pads (Table 2). Interestingly, a large number of alate species without tibial pads (Harpactorinae) are found in all the three ecosystems.

2. *Adaptive modifications and their evolutionary significance* :

Analysis of certain distinctive features such as the nature of development of the tibial pads; wings and coloration; relative curvature of the rostrum; predatory efficiency; egg deposition pattern; fecundity rate; longevity; sex ratio; eclosion-ecdysis emergence periodicities; relative development of cannibalistic tendency; camouflaging behaviour; hardiness etc. of more than 60 species of Reduviidae from the Palghat Gap and certain other areas of Southern India (Tamil Nadu) have led to the following conclusions.

a. Except *Lophocephala guerini,* a coprophagous harpactorine species of the tropical rainforest (Ambrose and Livingstone 1979) and a couple of species of Haematorrhophus (Echtrichodiinae) that feed on millipedes, all other recorded species are entomosuccivorous. Most of the tropical rainforest species, because of the abundance and diversity of prey (litter forms), are polyphagous whereas most of the species of the semi-arid zones and scrub jungles are predominantly monophagous, feeding on Camponotine ants and are rarely found to be oligophagous.

b. All the characteristic species of tropical rainforests are alate and are not sexually dimorphic in this regard. Most of them are brightly coloured, with reddish tinge predominating, without any kind of warning coloration. They are arboreal and conspicuously diurnal. They have no tibial pads and their rostrum is almost always straight or broadly crescentic. They are invariably found running by lifting the prey at ease (Fig. 56). Their eggs are glued to the substratum as well as to each other with cementing material, in batches (Fig. 57) of five to over hundred eggs in each batch. Eclosion, ecdysis and emergence periodicities have been found to be mostly in the forenoon and afternoon. There is no nymphal camouflaging and the insects are less hardy.

c. In the scrub jungles and in the semi-arid zones there are more number of apterous or micropterous or brachypterous species and the females of alate species are seldom alate. Most of them have well formed tibial pad

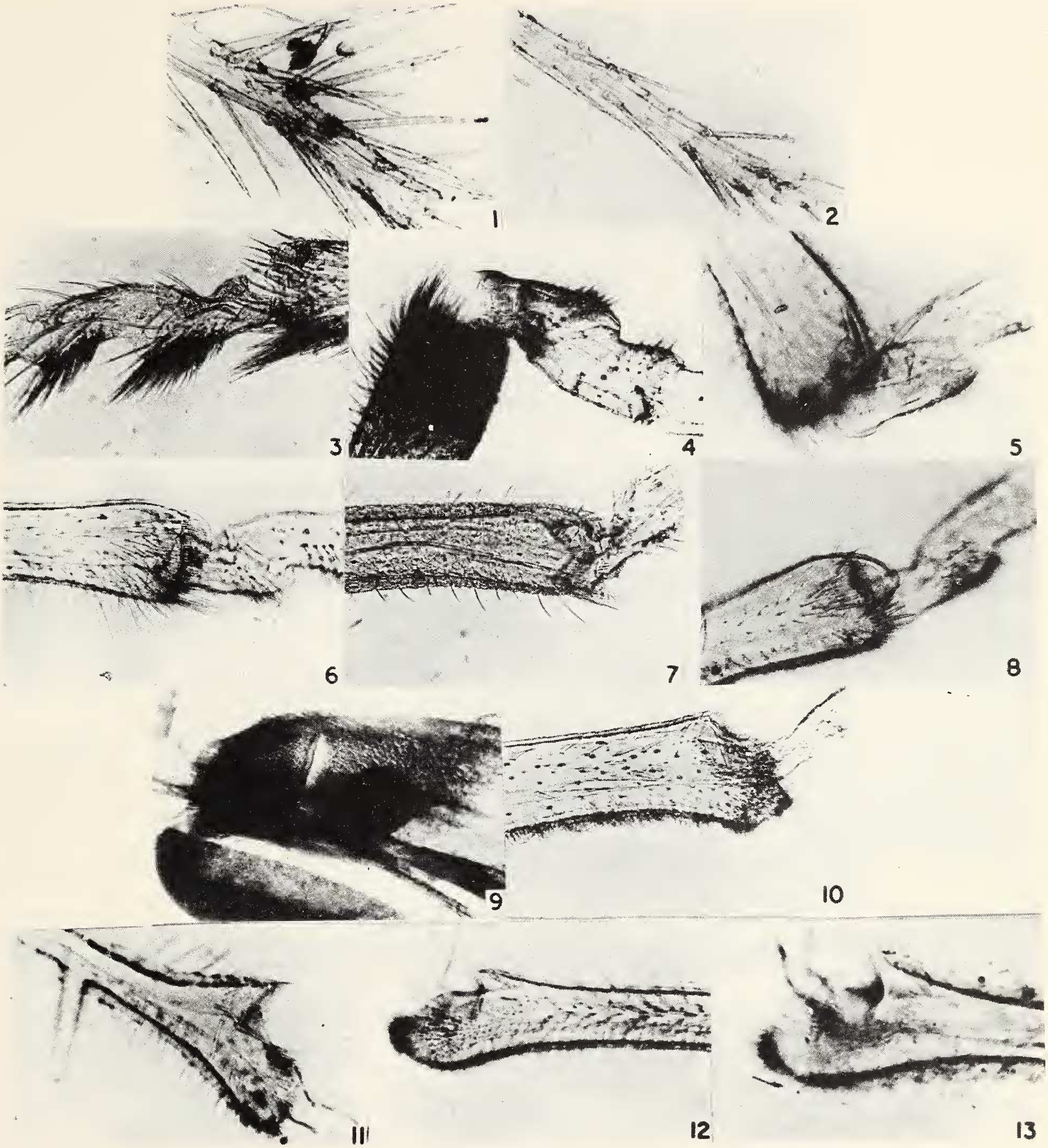

Fig. 1. *Holoptilus fasciatus* Reut.; Fig. 2. *Holoptilus melanospilus* Walk.; Fig. 3. *Oncocephalus annulipes* Stal; Fig. 4. *O. klugi* Dist. (reversed); Fig. 5. *O. notatus* Krug.; Fig. 6. *O. modestus* Reut.; Fig. 7. *O. fuscinotum* Reut.; Fig. 8. *Staccia diluta* Stal; Fig. 9. *Haematorrhophus* sp.; Fig. 10. *Neohaematorrhophus* sp.; Fig. 11. *Polididus armatissimus* Stal; Fig. 12. *Lophocephala guirini* Laporte; Fig. 13. *Sphedanolestes aterrimus* Dist.

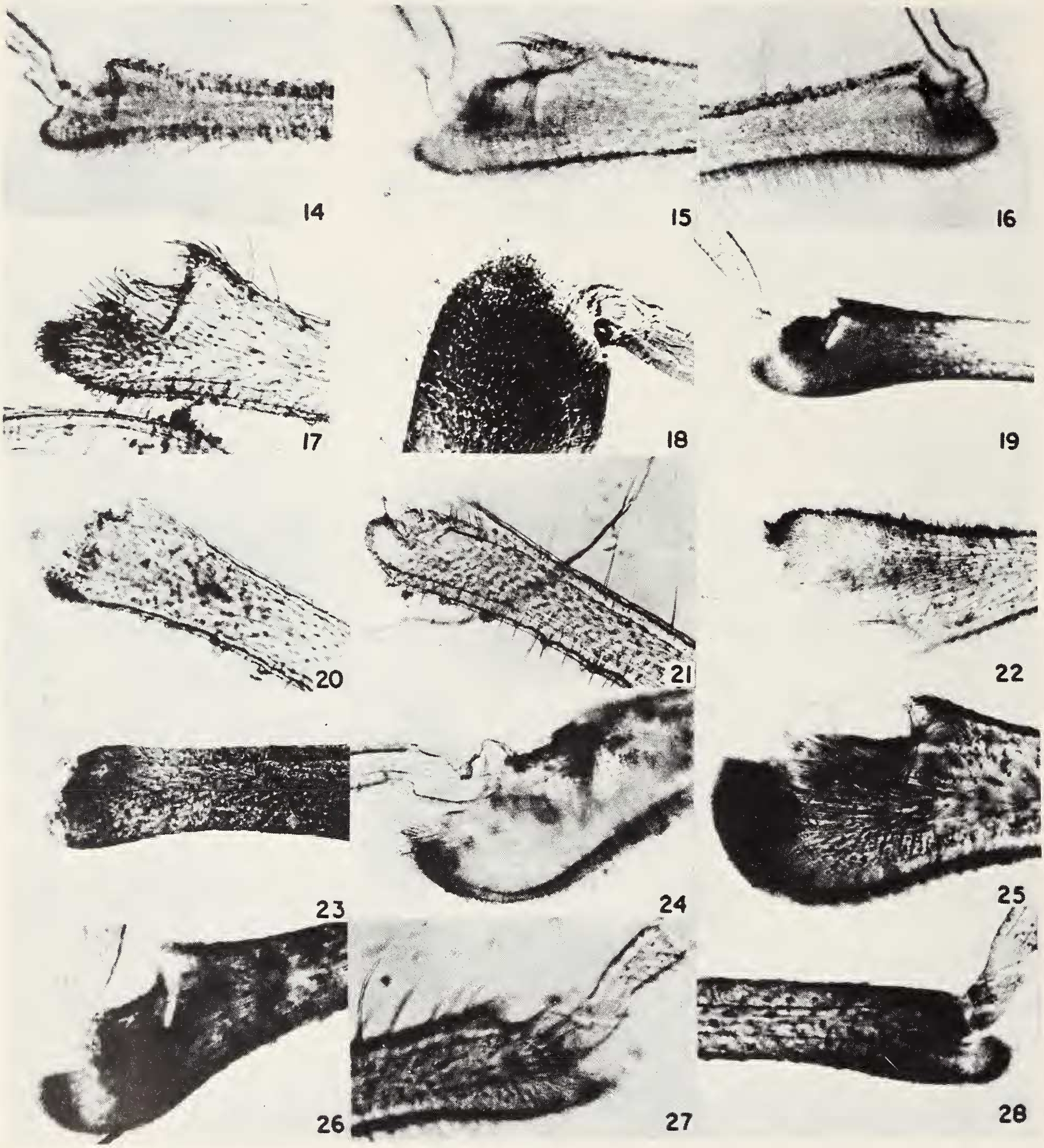

Fig. 14. *Rhaphidosoma atkinsoni* Bergr.; Fig. 15. *Coranus vitellinus* Dist.; Fig. 16. *Coranus* sp.; Fig. 17. *Coranus* sp.; Fig. 18. *Coranus atricapillus* Dist.; Fig. 19. *C. spiniscutis* Reut.; Fig. 20. *Irantha armipes* Stal; Fig. 21. *I. consobrina* Dist.; Fig. 22. *Endochus cingalensis* Stal (reversed); Fig. 23. *E. inoratus* Stal; Fig. 24. *Euogoras plagiatus* Burm.; Fig. 25. *Rhinocoris kumarii* sp. nov.; Fig. 26. *R. fuscipes* Fabr.; Fig. 27. *R. maginellus* Fabr.; Fig. 28. *R. longifrons* Stal.

TABLE 2

REDUVIIDAE OF SOUTHERN INDIA (TAMILNADU) — DIAGNOSTIC FEATURES PURPORTING TO EVOLUTIONARY TREND

INSECT	HABITAT	INSECT SIZE IN MM.		FORE TIBIA SIZE		FORE TIBIAL PAD SIZE IN MM.		TIBIAL INDEX (TL × TW/IL × IW)	TIBIAL PAD INDEX (TPL × TPW/TL × TW)	NATURE OF WING	NATURE OF ROSTRUM	NATURE OF EGG DEPOSITION
		L	W	L	W	L	W					
1	2	3	4	5	6	7	8	9	10	11	12	13
I. HOLOPTILINAE												
1. *Holoptilus fasciatus* Reut.	TRF	7.5	1.75	2.2	2.28	—	—	0.047	—	Alate	AS	—
2. *H. melanospilus* Walk.	TRF	6.5	1.5	2.1	0.2	—	—	0.045	—	„	AS	Glued
II. STENOPODINAE												
3. *Oncocephalus annulipes* Stal	SA,SJ	20.5	4.5	5.9	0.36	—	—	0.02	—	„	SC	Loose
4. *O. fuscinotum* Reut.	SA,SJ	9	2	2.2	0.28	—	—	0.034	—	„	SC	„
5. *O. klugi* Dist.	SA,SJ	17	4	3.5	0.46	—	—	0.02	—	„	SC	„
6. *O. modestus* Reut.	SA,SJ	18	3	3.2	0.4	—	—	0.02	—	„	SC	„
7. *O. notatus* Klug.	SA,SJ	14	3	3.86	0.36	—	—	0.03	—	„	SC	„
8. *Sastrapada baerensprungi*	SA,SJ	18	2	2.66	0.3	—	—	0.02	—	„	AS	—
9. *Staccia diluta* Stal	SA,SJ	8.5	1.5	1.64	0.24	—	—	0.03	—	„	SC	—
III. ECHTRICHODIINAE												
10. *Neohaematorrhophus* sp.	SA,SJ	7.5	2.75	2.0	0.4	—	—	0.04	—	M-al- F-apt.	C	Glued
11. *Haematorrhophus* (?)	SA,SJ,TRF	25	8	7.6	1.44	3.12	0.86	0.055	0.245	apt.	C	Loose

IL = Insect length; IW = Insect Width; TL = Tibial length;
TW = Tibial Width; TPL = Tibial pad length; TPW = Tibial pad width.

TABLE 2 (contd)

1	2	3	4	5	6	7	8	9	10	11	12	13
IV. HARPACTORINAE												
12. *Coranus atricapillus* Dist.	SA	6	2	1.96	0.30	0.08	0.24	0.05	0.03	Alate	SC	Glued
13. *C. spiniscutis* Reut.	SA	9.5	3	2.76	0.30	—	—	0.03	—	,,	SC	,,
14. *C. vitellinus* Dist.	SA,SJ	9.75	3.5	3.04	0.30	—	—	0.03	—	,,	SC	,,
15. *Coranus* sp.	SA	9.5	2.75	3.3	0.34	—	—	0.04	—	,,	SC	,,
16. *Coranus* sp.	SA	9	3.5	3.44	0.24	—	—	0.026	—	,,	SC	,,
17. *C. gilvus*	TRF	17	4.5	5.3	0.54	0.4	0.48	0.037	0.06	,,	SC	,,
18. *Endochus cingalensis* Stal.	TRF	18	3.75	7.8	0.48	—	—	0.055	—	,,	SC	,,
19. *E. inornatus* Stal	TRF	22	3.5	8.9	0.4	—	—	0.046	—	,,	SC	—
20. *E. plagiatus* Bwym.	TRF	18	2.5	6	0.28	—	—	0.037	—	,,	C	—
21. *Irantha armipes* Stal.	TRF	11.5	2	3.46	0.36	—	—	0.043	—	,,	S	Glued
22. *I. consobrina* Dist.	TRF,SJ	9	1.5	3.4	0.26	—	—	0.065	—	,,	S	,,
23. *Lophocephala guerini* Laporte	TRF	16.5	4.00	5.5	0.4	—	—	0.033	—	Alate	S	Glued
24. *Polididus armatissimus* Stal	TRF	10.5	1.5	3.4	0.66	—	—	0.14	—	,,	C	Loose
25. *Rhaphidosoma atkinsoni* Bergr.	SJ,SA TRF	22	1.2	10.6	0.34	—	—	0.116	—	Apt.	S	Glued
26. *Rhinocoris marginatus* Fabr.	SA,SJ	18	5.5	6.9	0.56	—	—	0.038	—	Alate	SC	Glued
27. *R. marginellus* Fabr.	SA	11.5	4.00	3.9	0.44	—	—	0.037	—	Alate	SC	,,
28. *Rhinocoris* sp.	SJ	18.5	5.00	7.2	0.5	—	—	0.038	—	,,	SC	,,
29. *R. fuscipes* Fabr.	SA,SJ TRF	12.85	3.8	4.95	0.28	0.2	0.36	0.028	—	,,	SC	,,
30. *R. longifrons* Stal	SA,SJ	14	4.00	3.84	0.32	0.24	0.02	0.028	0.039	,,	SC	,,
31. *Sphedanolestes aterrimus* Dist.	SJ,TRF	8.5	1.5	3.2	0.3	—	—	0.075	—	,,	AS	
32. *S. ater*	TRF	18	3.5	10.9	0.24	0.24	0.08	0.04	0.001	,,	C	—

TABLE 2 (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13
V. SALYAVATINAE												
33. *Lisarda annulosa* Stal	SA,SJ	10.5	1.5	2.76	0.4	0.66	0.24	0.07	0.143	,,	SC	Loose
34. *Paralisarda* sp.	SJ,SA	10	2.00	1.94	0.52	0.64	0.16	0.05	0.101	Apt.	C	Loose
35. *Petelochirus brachialis* Stal	SJ	14	2.5	3.64	1.74	0.24	0.84	0.18	0.032	Alate	C	—
VI. ACANTHASPIDINAE												
36. *Acanthaspis pedestris* Stal	SA,SJ TRF	13.5	3.75	3.7	0.56	1.24	0.26	0.15	0.156	Mcp	AC	Loose
37. *A. siva* Dist.	SA,SJ	16.5	5.5	5.24	0.68	3.2	0.6	0.039	0.539	Alate	AC	Loose
38. *A. quinquespinosa* (L.) Fabr.	SA,SJ	16.5	5.5	5.04	0.6	1.8	0.28	0.033	0.167	,,	AC	Loose
39. *A. zebraica* Dist.	SA	11	3.5	2.44	0.46	0.84	0.16	0.029	0.119	,,	AC	Loose
40. *Edocla slateri* Stal	SA,SJ	9.5	3.25	2.54	0.26	0.8	0.2	0.021	0.242	,,	AC	Glued
41. *Triatoma rubrofasciatus* DeGeer	SA	23	5.75	5.8	0.6	0.2	0.36	0.026	0.02	,,	AS	Loose
VII. PIRATINAE												
42. *Catamiarus brevipennis* Serv.	SA,SJ	25	8.0	6.0	1.28	3.5	0.76	0.038	0.338	Br.	Sh. C.	Loose
43. *Ectomocoris atrox* Stal	SA,SJ	14	4	4.44	0.66	3.44	0.60	0.05	0.703	Alate	Sh. C	Loose
44. *E. cordatus* Wolff.	SA,SJ	12.5	2.5	3.16	0.48	2.16	0.40	0.049	0.57	,,	Sh. C	Loose
45. *E. cordiger* Stal	SA,SJ	14	4.25	4.1	0.64	3.2	0.56	0.044	0.683	Alate	Sh. C	Loose
46. *E. elegans* Fabr.	SA,SJ	15	4	4.4	0.44	3.06	0.56	0.032	0.885	,,	Sh. C	,,
47. *E. erebus* Dist.	SA,SJ TRF	15	4.0	4.1	0.46	3.10	0.56	0.031	0.92	Br.	Sh. C	,,
48. *E. gangeticus* Bergr.	SA,SJ	15	3.5	4.75	0.54	3.8	0.66	0.048	0.98	Br.	Sh. C	--
49. *E. ochropterus* Stal	SA	16	3.5	5.9	0.68	3.44	0.66	0.072	0.566	Br.	Sh. C	—
50. *E. tibialis* Dist.	SA,SJ	15	3.5	4.76	0.50	3.08	0.52	0.046	0.672	Br.	Sh. C	Loose
51. *E. quadriguttatus* Fabr.	SA,SJ	9	2.75	5.1	0.54	4.4	0.64	0.111	1.02	Alate	Sh. C	,,
52. *Ectomocoris* sp.	SA,SJ	15	4	3.3	0.30	2.60	0.36	0.017	0.945	Alate	Sh. C	,,
53. *Ectomocoris* sp.	SA,SJ	15	4	4.54	0.64	2.8	0.7	0.048	0.675	,,	Sh. C	,,
54. *Piratus affinis* Serv.	SA,SJ TRF	23	5.5	5.2	1.06	0.56	2.00	0.043	0.203	M-al. F-apt.	Sh. C	Loose
55. *P. quadrinotatus* Fabr.	SA,SJ	18	4.5	2.4	0.36	1.2	0.36	0.01	0.5	Alate	Sh. C	Loose

TABLE 2 (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13
56. *Pirates* sp.	SA,SJ	13.5	3.75	3.24	0.36	1.36	0.2	0.023	0.233	,,	Sh. C	,,
57. *Pirates* sp.	SA,SJ	21	4	4.36	1.0	1.80	0.48	0.051	0.198	,,	Sh. C	—
58. *Sirthenea flavipes* Stal	SA,SJ	12.5	3	2.7	0.4	1.4	0.4	0.029	0.519	,,	Sh. C	—
VIII. NABIDINAE												
59. *Nabis capsiformis* Germ.	TRF	9	1.5	2.38	0.24	0.24	0.08	0.042	0.034	,,	SC	—

AC = Acutely curved; Al = Alate; Apt. = apterous; AS — Almost straight; Br = Brachypterous; C = Crescentic; F = Female; L = Length; M = Male; Mcp = Micropterous; S — Straight; SA= Semiarid zone; SJ = Scrub jungle; SC = Slightly crescentic; Sh.C = Sharply crescentic; TRF = Tropical rainforest; and W = Width.

on both the fore and mid tibiae and very rarely on the foretibiae alone. Eggs of most species are deposited singly, haphazardly without any cementing material and have more number of batches with less number of eggs in each batch. Eclosion, ecdysis and emergence periodicities are found mostly at dusk or at night. The rostrum is acutely curved (Fig. 55) and the prey is seldom lifted. Most characteristic species are with warning coloration (Black and yellow) and are extremely hardy. Cannibalistic tendency is significantly developed and nymphal camouflaging is found only in Acanthaspidinae where this tendency is better defined and characterised.

The relative development of the tibial pads has been considered here as a visible indication of predatory efficiency in Reduviidae (Livingstone and Ambrose 1978a) and this character has been taken as a significant index of adaptive evolution of the Reduviidae of the scrub jungles and semi-arid zones of this region. All other characters such as progressive curvature of the rostrum; nature of the eggs and the pattern of oviposition; eclosion, — ecdysis — emergence periodicity patterns, alary polymorphism; cannibalistic tendency and nymphal camouflaging and warning coloration are considered supplementary attributes to predatory efficiency in an adverse ecosystem.

According to the steps in the origin and evolution of tibial pads as proposed here (Table 3), the Holoptilinae [*Holoptilus fasciatus* (Fig. 1) and *H. melanospilus* (Fig. 2)] have very slender, more elongated tibiae, provided with very long, slender, (plumose type) movable spines. This type is structurally the least specialized in prey capture, presumably originated from Cimicid stock. The next step in the development of tibial pad is marked by better defined concentration of sharp spines on the ventral extremity of each tibia as well as the tarso-

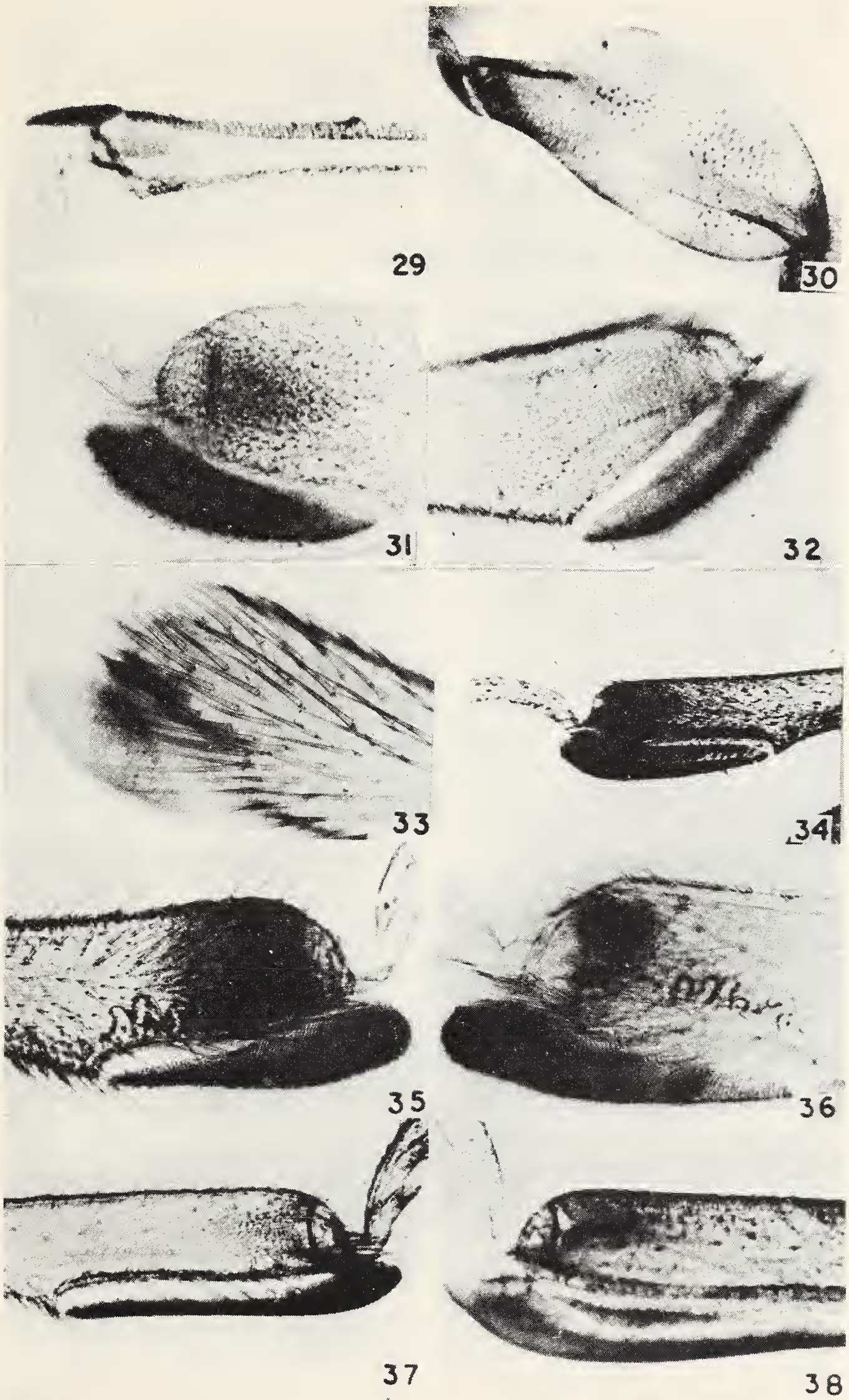

Fig. 29. *Nabis capsiformis* Germ (reversed); Fig. 30. *Petalochirus brachialis* Stal; Fig. 31. *Paralisarda* sp.; Fig. 32. *Lisarda annulosa* Stal; Fig. 33. *Triatoma rubrofasciatus* Degeer; Fig. 34. *Acanthaspis pedestris* Stal; Fig. 35. *A. zebraica* Dist.; Fig. 36. *Edocla slateri* Stal; Fig. 37. *Acanthaspis quinquespinosa* (L.) Fabr.; Fig. 38. *A. siva* Dist.

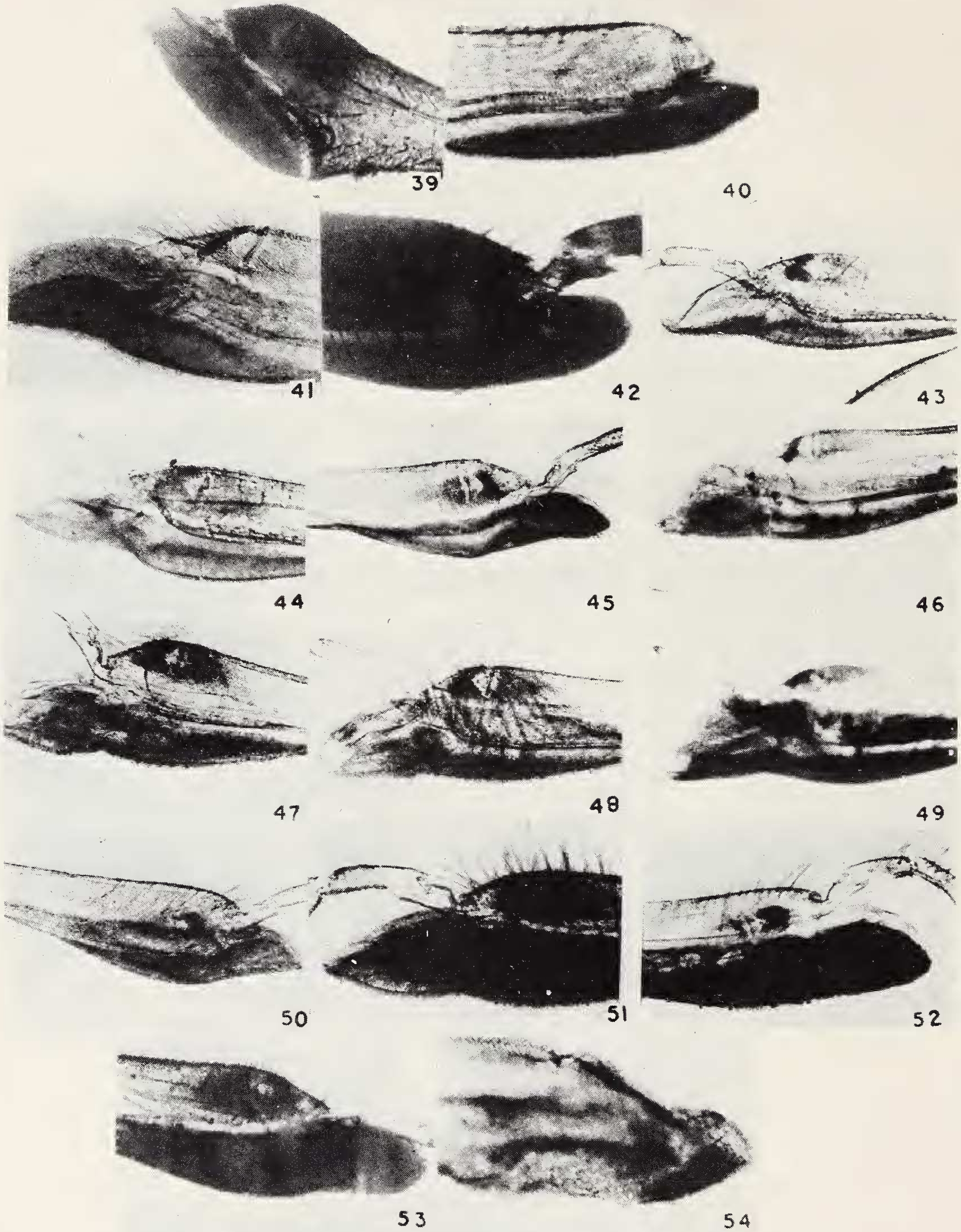

Fig. 39. *Piratus affinis* Serv.; Fig. 40. *Piratus* sp.; Fig. 41. *P. quadrinotatus* Fabr.; Fig. 42. *Catamiarus brevipennis* Serv.; Fig. 43. *Ectomocoris elegans* Fabr.; Fig. 44. *E. erebus* Dist.; Fig. 45. *Ectomocoris* sp.; Fig. 46. *E. atrox* Stal.; Fig. 47. *E. cordatus* Wolff.; Fig. 48. *Ectomocoris* sp.; Fig. 49. *E. ochropterous* Stal; Fig. 50. *E. cordiger* Stal; Fig. 51. *E. quadriguttatus* Fabr.; Fig. 52. *E. gangeticus* Bergr.; Fig. 53. *E. tibialis* Dist.; Fig. 54. *Serthenea flavipes* Stal.

TABLE 3

PROPOSED STEPS IN THE ORIGIN AND EVOLUTION OF TIBIAL PADS IN REDUVIIDAE